HW3

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1 HW 3: Turing Machines

1.1 Problem 1

A *Turing machine with left-reset* is similar to an ordinary Turing machine but the transition function has the form

$\delta : Q \times \Gamma \to Q \times \Gamma \times \{R, RESET\}$

The semantics of the $RESET$ move is that the Turing machine will go all the back to the left-most side of the tape, instead of just moving a step left. Prove that Turing machines with left reset are equivalent to ordinary Turing machines. To do this you'll need to

- show that you can turn a Turing machine with left reset into an ordinary Turing machine (the easy part)
- show that you can turn an ordinary Turing machine into a Turing machine with left reset (the hard part)

1.2 Problem 2

Show that the Turing-decidable languages are closed under

1. union

2. intersection

3. complement

1.3 Problem 3

Give an informal description of the following languages

- $\{w|w$ contains twice as many 0s as 1s$\}$
- $\{w|w$ has matching parentheses and a length that's a power of 2$\}$

1.4 Problem 4

Show that the Turing *recognizable* languages are closed under

- Kleene star
- concatenation
- reversal

Are the *recognizable* languages closed under complement? Can you give a counter-example?